

that it satisfies the required 12-dB margin for nominal system performance and 6-dB margin for worst-case system performance.

(2) When demonstrating the 12-dB margin, each link analysis must account for the following nominal system performance and attenuation factors:

- (i) Path losses due to plume or flame attenuation;
- (ii) Vehicle trajectory;
- (iii) Ground system and airborne system radio frequency characteristics; and
- (iv) The antenna gain value that ensures that the margin is satisfied over 95% of the antenna radiation sphere surrounding the launch vehicle.

(3) When demonstrating the 6-dB margin, each link analysis must account for the following worst-case system performance and attenuation factors:

- (i) The system performance and attenuation factors of paragraph (f)(2) of this section;
- (ii) The command transmitter failover criteria of §417.303(g) including the lowest output power provided by the transmitter system;
- (iii) Worst-case power loss due to antenna pointing inaccuracies; and
- (iv) Any other attenuation factors.

(g) *Sneak circuit*. Each electronic component that contains an electronic inhibit that could inhibit the functioning, or cause inadvertent functioning of a flight termination system or command control system, must undergo a sneak circuit analysis. The analysis must demonstrate that there are no latent paths of an unwanted command that could, when all components otherwise function properly, cause the occurrence of an undesired, unplanned, or inhibited function that could cause a system anomaly. The analysis must determine the probability of an anomaly occurring for input to the system reliability analysis of paragraph (b) of this section.

(h) *Software and firmware*. Any computing system, software, or firmware that performs a software safety critical function must undergo the analysis needed to ensure reliable operation and satisfy §417.123.

(i) *Battery capacity*. A flight termination system must undergo an anal-

ysis that demonstrates that each flight termination system battery has a total amp hour capacity of no less than 150% of the capacity needed during flight plus the capacity needed for load and activation checks, preflight and launch countdown checks, and any potential launch hold time. For a launch vehicle that uses any solid propellant, the analysis must demonstrate that the battery capacity allows for an additional 30-minute hang-fire hold time. The battery analysis must also demonstrate each flight termination system battery's ability to meet the charging temperature and current control requirements of appendix D of this part.

(j) *Survivability*. A flight termination system must undergo an analysis that demonstrates that each subsystem and component, including their location on the launch vehicle, provides for the flight termination system to complete all its required functions when exposed to:

- (1) Breakup of the launch vehicle due to aerodynamic loading effects at high angle of attack trajectories during early stages of flight, including the effects of any automatic or inadvertent destruct system;
- (2) An engine hard-over nozzle induced tumble during each phase of flight for each stage; or
- (3) Launch vehicle staging, ignition, or any other normal or abnormal event that, when it occurs, could damage flight termination system hardware or inhibit the functionality of any subsystem or component, including any inadvertent separation destruct system.

§417.311 Flight safety crew roles and qualifications.

(a) A flight safety crew must operate the flight safety system hardware. A flight safety crew must document each flight safety crew position description and maintain documentation on individual crew qualifications, including education, experience, and training as part of the personnel certification program required by §417.105.

(b) A flight safety crew must be able to demonstrate the knowledge, skills, and abilities needed to operate the

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flight safety system hardware in accordance with § 417.113.

(1) A flight safety crew must have knowledge of:

(i) All flight safety system assets and responsibilities, including:

(A) Communications systems and launch operations procedures;

(B) Both voice and data systems;

(C) Graphical data systems;

(D) Tracking; and

(E) Telemetry real time data;

(ii) Flight termination systems; and

(iii) Contingency operations, including hold, recycle and abort procedures.

(2) An individual who monitors vehicle performance and performs flight termination must have knowledge of and be capable of resolving malfunctions in:

(i) The application of safety support systems such as position tracking sources;

(ii) Digital computers;

(iii) Displays;

(iv) Command destruct;

(v) Communications;

(vi) Telemetry;

(vii) All electrical functions of a flight termination system;

(viii) The principles of radio frequency transmission and attenuation;

(ix) The behavior of ballistic and aerodynamic vehicles in flight under the influence of aerodynamic forces; and

(x) The application of flight termination rules.

(3) An individual who operates flight safety support systems must have knowledge of and be capable of resolving malfunctions in:

(i) The design and assembly of the flight safety support system hardware;

(ii) The operation of electromechanical systems; and

(iii) The nature and inherent tendencies of the flight safety system hardware being operated.

(4) An individual who performs flight safety analysis must have knowledge of orbital mechanics and be proficient in the calculation and production of range safety displays, impact probabilities, and casualty expectations.

(c) Flight safety crew members must complete a training and certification program to ensure launch site familiarization, launch vehicle familiarization, flight safety system functions,

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equipment, and procedures related to a launch before being called upon to support that launch. Each flight safety crew member must complete a preflight readiness training and certification program. This preflight readiness training and certification program must include:

(1) Mission specific training programs to ensure team readiness.

(2) Launch simulation exercises of system failure modes, including nominal and failure modes, that test crew performance, flight termination criteria, and flight safety data display integrity.

Subpart E—Ground Safety

§ 417.401 Scope.

This subpart contains public safety requirements that apply to launch processing and post-launch operations at a launch site in the United States. Ground safety requirements in this subpart apply to activities performed by, or on behalf of, a launch operator at a launch site in the United States. A licensed launch site operator must satisfy the requirements of part 420 of this chapter.

§ 417.402 Compliance.

(a) *General.* A launch operator's ground safety process must satisfy this subpart.

(b) *Ground safety analysis conducted for launch at a Federal launch range.* This provision applies to all sections of this subpart. The FAA will accept a ground safety process conducted for a launch from a Federal launch range without need for further demonstration of compliance to the FAA if:

(1) A launch operator has contracted with a Federal launch range for the provision of the ground safety process; and

(2) The FAA has assessed the Federal launch range, through its launch site safety assessment, and found that the Federal launch range's ground safety process satisfies the requirements of this subpart. In this case, the FAA will treat the Federal launch range's process as that of a launch operator.

(c) *Toxic release hazard analysis conducted for launch processing at a Federal launch range.* The FAA will accept a